

## WHAT IS CLAIMED IS:

1. A filter arrangement for filtering lubricating oil wherein the lubricating oil contains contaminants in the form of small particles, large particles and sludge, the filter arrangement comprising:

a first filter element having a filter media with a dirty side and a clean side for filtering relatively small particles from the lubricating oil;

a second filter element having a filter media with a dirty side and a clean side for removing sludge from the lubricating oil,

a centrifugal separator for removing large particles from the lubricating oil, and

a canister housing for containing the first and second filter elements and the centrifugal separator.

2. A filter arrangement according to claim 1 wherein the first and second filter elements and centrifugal separator are coaxially mounted within the canister housing.

3. The filter of claim 2 wherein the first and second filter elements are annular with the first filter element being stacked above the second filter element and wherein the centrifugal separator is disposed upstream of at least a majority of the filter media of the first filter element.

4. The filter of claim 3 further including a flow deflecting element for imparting a non-axial component to filtered lubricating oil flowing from the clean side of the first filter element down past the clean side of the second filter element to mix with filtered lubricating oil from the first filter element.

5. The filter arrangement of claim 4 wherein the centrifugal separator is configured as an array of fins disposed in an annular space between the filter elements and canister housing.
6. The filter arrangement of claim 4 wherein the flow deflecting element comprises a spiral element which imparts a spiral component to the flow of the lubricating oil flowing out of the second filter element.
7. The filter arrangement of claim 1 wherein the centrifugal separator is configured as an array of fins disposed in an annular space between the filter elements and canister housing.
8. A filter for filtering a fluid comprising:
  - a canister housing having a first end with radially positioned inlet openings and a central opening disposed about a central axis, and having a closed second end;
  - a first filter element having a first annular filter media defining a first substantially cylindrical hollow core, the first filter element being disposed adjacent the first end of the canister housing;
  - a second filter element having second annular filter media defining a second substantially cylindrical hollow core, the second filter element being stacked axially on the first filter element;
  - the first and second filter elements being radially spaced from the housing wall to define an annular space;
  - a flow deflecting element connecting the second hollow core to the first hollow core, the flow deflecting element comprising a flow deflector which imparts a rotational component to the fluid as the fluid flows axially from the first hollow core to the second hollow core, wherein fluid flowing radially through the first filter media mixes with the rotating fluid which has been

filtered by the second filter media before passing axially through the outlet of the filter cartridge, and

a centrifugal separator disposed at the annular space between the filter elements and the housing wall for imparting rotary motion to fluid in the annular space.

9. The filter of claim 8, wherein the flow deflecting element comprises an annular channel formed about a core, the annular channel having the flow deflector therein.

10. The filter of claim 9, wherein the first flow deflector comprises at least one axially extending angularly displaced rib.

11. The filter of claim 10, wherein the rib extends across the annular channel and supports the core therein.

12. The filter of claim 11, wherein the core has at least one end closed to axial passage of fluid.

13. The filter of claim 13, wherein the core is hollow and has a first closed end and a second open end, the open end being in the second hollow core defined by the second annular filter element.

14. The filter of claim 1 wherein the centrifugal separator comprises an array of fins which are oriented at an angle to the axis of the canister housing.

15. The filter of claim 14 wherein the array of fins is disposed around the first filter adjacent to the first end of the canister.

16. The filter of claim 15 wherein the array of fins are disposed on a plastic ring which fits around the first filter.

17. The filter of claim 8 wherein the fluid is engine lubricating oil having small particles, large particles and sludge entrained therein, and wherein the small particles are filtered out by the first filter element, the large particles are precipitated out by the centrifugal separator, and the sludge filtered out by the second filter element.

2025-03-04 10:00:00